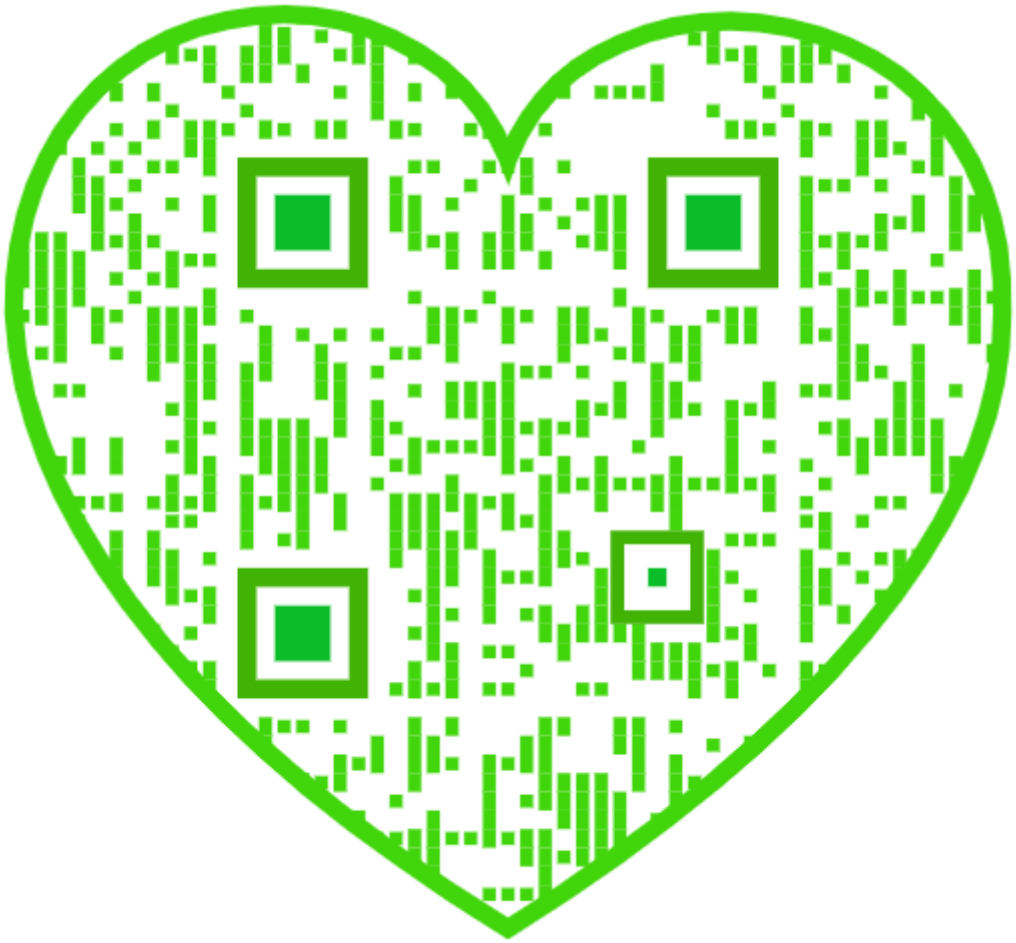

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PORTO RICO AGRICULTURAL EXPERIMENT STATION
MAYAGUEZ, PORTO RICO
Under the supervision of the
UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 30

COFFEE VARIETIES IN PORTO RICO

BY

T. B. McCLELLAND, Horticulturist

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PORTO RICO AGRICULTURAL EXPERIMENT STATION.

[Under the supervision of the Office of Experiment Stations, United States Department of Agriculture.]

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During the 20-year period 1901 to 1920, the three principal articles of export from Porto Rico were, in the order named, sugar, coffee, and cigars. While sugar held first place each year, coffee held second place for 12 of the 20 years and for the period as a whole. The average annual exports aggregated 35,000,000 pounds, with a maximum annual exportation of over 51,000,000 pounds. In 1920, 32,776,754 pounds of coffee, valued at more than $9,000,000, were exported. This valuation is the highest since the American occupation. The coffee crop thus holds a very prominent place in the agriculture of Porto Rico, is one for which another crop can not readily be substituted, and is peculiarly adapted to the mountainous and often rather inaccessible regions in which it is grown.

The Porto Rico Experiment Station, since its establishment, has for these reasons been doing everything possible to develop the industry by promoting better agricultural methods among local growers, and introducing and testing numerous varieties and species not formerly grown on the island to ascertain which are best suited to local conditions. This bulletin gives the results of some of the tests in order that growers contemplating planting new varieties may know with what success they have been grown at the station.[1]

KINDS OF COFFEES.

The coffees of commercial importance fall into three groups, the Arabian, the Liberian, and the robustoid. To the Arabian group belong the coffees known as Porto Rican, Padang, Bourbon, Pointed Bourbon, Erecta, Columnaris, Maragogipe, San Ramón,

[1] Varieties and species having little or no economic value on the island are not discussed in the bulletin.

Mocha, and Murta; to the Liberian group belong Liberica, Excelsa, Dewevrei, Abeokutæ, and Dybowskii; and to the robustoid group belong Robusta, Canephora, Laurentii, Quillou, *Coffea ugandæ* hybrid, and *C. congensis* hybrids.

ARABIAN GROUP.

The Arabian is the largest of the three groups and includes the greater part of the coffees of South and Central America, the West Indies, that known as Java,[2] and in short what the public generally knows as "coffee" where no qualifying adjective is applied. In this group are found the best cup coffees.

The leaves of the Arabian group are smaller and thinner than those of the Liberian group, and the trees[3] are smaller than those of either the Liberian or the robustoid group. The pulp is much thinner than that of many members of the Liberian group, and the ripe fruit drops more readily, necessitating picking at shorter intervals.

Porto Rican Coffee.

According to historians, coffee of Arabian stock was introduced from the Far East into Java and other places, whence it spread to Martinique toward the close of the first quarter of the eighteenth century. Within the next quarter of the century it found its way to the other islands of the West Indies, and was taken by emigrants from Haiti to Porto Rico, where it is said to have produced a crop of some 700,000 pounds in 1770.[4] A century later the annual exportation from Porto Rico ranged from 15,000,000 to 25,000,000 pounds, and by 1896 had reached the maximum, 57,961,291 pounds, with the second highest exportation, 51,125,620 pounds, in 1915. According to the Federal census, 159,860 acres of coffee were harvested on the island in 1919.[5]

Porto Rican coffee is botanically known as *Coffea arabica*. The shrub is a small evergreen which attains a height of 10 to 15 feet. When young it has a single, very erect trunk or stem which later bends under the weight of its crop. Other stems of similar form and habit then develop along it, giving to the whole a somewhat bushy appearance. The lateral branches are opposite in arrangement, horizontal, and in pairs. Occasionally they occur in whorls of three. The leaves, which are dark, glossy green on the upper surface and light green underneath, opposite, and in pairs, are generally $1\frac{1}{2}$ to $2\frac{1}{2}$ inches broad by 4 to 7 inches long, the length being $2\frac{1}{2}$ to 3 times the breadth. They are elliptical in form, with acuminate tip and attenuate base. (Pl. I, fig. 1.)

The flowers are pure white with five or six petals, and are borne on short pedicels in one to four axillary clusters of one to four flowers each. The blossoming season is irregular, and flowering may take place at any time from December to May. At Mayaguez the principal blossoming occurs usually in February and March, and sometimes in January and April, the season being earlier on

[2] At present the Arabian coffee forms a very small percentage of the Javan crop.
[3] The term "tree" is arbitrarily used in this bulletin to cover all forms of *Coffea* spp.
[4] Informe de la cáfe. National Coffee Growers' Association, Ponce, P. R., 1910, p. 128.
[5] Ann. Rpt. Governor of Porto Rico, 1920, p. 319.

the coast than in the hills. Generally there are two or three major blossomings, followed by several minor ones.

Upon fading the flowers are replaced by small berries, which when ripe resemble carmine cherries, hence the term "coffee-cherry." The fruit requires from six and one-half to seven months to mature. At Mayaguez the main crop is gathered during September, October, and November at intervals usually of about two weeks. Table 1 gives the ripening season for Porto Rican coffee, as shown by the harvest over a period of seven years from experimental plats located 7 miles east of Mayaguez, and for other varieties grown at the station.

TABLE 1.—*Ripening season and percentage of crop harvested each month for the respective varieties.*

Variety.	Monthly quantity harvested for the whole period.											
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Mocha	5	37	52	6	.....	.....	.....	.....	.....	.....	.....	.....
Bourbon	15	31	37	14	3	.....	.....	.....	.....	.....	.....	.....
Murta	6	40	38	11	5	.....	.....	.....	.....	.....	.....	.....
Porto Rican, Las Vegas	14	32	24	27	3	.....	.....	.....	.....	.....	.....	.....
Erecta	3	39	40	13	5	.....	.....	.....	.....	.....	.....	.....
Padang	1	31	41	22	5	.....	.....	.....	.....	.....	.....	.....
San Ramón	2	12	28	21	26	11	.....	.....	.....	.....	.....	.....
Maragogipe	.....	7	34	37	18	4	.....	.....	.....	.....	.....	.....
Columnaris	.....	5	27	40	22	6	.....	.....	.....	.....	.....	.....
Canephora	.....	.....	1	13	29	44	10	3	.....	.....	.....	.....
Quillou	.....	.....	1	15	27	45	9	2	1	.....	.....	.....
Congensis hybrids	.....	.....	3	13	20	43	13	8	.....	.....	.....	.....
Robusta	.....	.....	1	7	19	46	18	9	.....	.....	.....	.....
Dewevrei	.....	.....	2	6	26	28	20	9	4	1	1	3
Liberica	2	.....	.....	1	9	41	26	16	4	1	.....	.....
Excelsa	.....	.....	.....	.....	.....	5	5	28	22	18	15	7

In 10 samples of Porto Rican coffee gathered in the vicinity of Mayaguez the number of cherries per liter[6] ranged from 330 to 415, with an average of 357.

In Porto Rico coffee is picked by the almud,[7] a measure of 20 liters' capacity. The average weight of an almud of coffee cherries is 28 pounds and 3 ounces as determined by measuring and weighing over 2¼ tons of coffee cherries during a period of more than five years. Table 2 gives some idea of the size of the cherries of various coffees, based upon the average number per liter.

TABLE 2.—*Number of cherries per liter of different varieties of coffee.*

Variety.	Average number of cherries per liter.[a]	Variety.	Average number of cherries per liter.[a]
Liberica	139	Columnaris	388
Maragogipe	209	Excelsa	410
Dewevrei (general)	263	San Ramón	515
Dewevrei (tree No. 2510)	268	Mocha	543
Padang	328	Robusta	564
Erecta	352	Congensis hybrids	638
Murta	355	Canephora	654
Porto Rican (Mayaguez)	357	Quillou	681

[a] Computed from the count of cherries in 4 to 21 liter measures, excepting *C. dewevrei* tree No. 2510.

[6] In estimating size for other varieties this number is, for purposes of comparison, arbitrarily assumed to be representative of size of Porto Rican coffee cherries as grown in this vicinity.

[7] One almud of cherries yields about 5 pounds of marketable coffee. One pound of cherries equals about 0.22 pound of marketable coffee, and 1 liter of cherries about 0.3 pound of marketable coffee. Approximately 300 pounds of marketable coffee is produced per acre in Porto Rico per annum.

Each cherry usually contains two oval seeds, termed "beans" in commerce. (Pl. I, fig. 2.) These are greenish or grayish olive in color, elliptical in outline, rounded on one side and flattened on the other, with a slightly curved suture furrowing the flat side. They are placed in the cherry with their flat sides together, and when one becomes abortive the other rounds out on what was the flat side and develops into an oval bean which is called a "peaberry." Being rather attractive in appearance, the peaberry enjoys an unmerited reputation for superiority over the flat bean and retails at a slightly higher price. The coffees of the Arabian group contain a smaller percentage of peaberries than do those of the other two groups, and Porto Rican samples of the group when examined at the station showed a low content of peaberries. The beans are inclosed in a cartilaginous membrane known as the parchment, which is underlain by a semitransparent membrane termed the "silver skin."

Representative beans measure 10 to 11 millimeters in length and 6 to 8 millimeters in breadth. The number of beans in a pound of Porto Rican marketable coffee varies with the altitude and conditions under which the crop is produced, and may range from about 2,400 to 3,000 or more. Judging from several counts, it is thought that about 2,800 beans may be considered a representative number for this vicinity, where a smaller cherry is produced than at higher elevations.

Table 3 shows the number of beans to a pound of sun-dried, cleaned coffee, the proportion of peaberries to a pound of coffee, and the weight of moisture-free beans of the different varieties.

TABLE 3.—*Comparative size of beans, proportion of peaberries in pound, and weight of different varieties.*

Variety.	Number of beans to pound of sun-dried, cleaned coffee.[1]	Proportion of peaberries in pound.	Weight of 1,000 dry beans.
		Per cent.	*Grams.*
Liberica	1,612	14	242.4
Maragogipe	1,674	6	235.9
Dewevrei (tree No. 2510)	2,144	10	189.2
Dewevrei (general)	2,164	23	186.6
Padang	2,494	11	157.3
Excelsa	2,707	29	154.1
Porto Rican, Las Vegas	2,725	6	146.9
Columnaris	2,749	10	146.4
Erecta	2,742	17	144.7
Robusta	2,726	24	144.4
Canephora	2,791	41	143.1
Porto Rican (Mayaguez)	2,857	8	138.9
Quillou	2,903	23	136.9
Bourbon	2,973	11	130.6
Congensis hybrids (planting No. 1)	3,285	29	122.5
Congensis hybrids (planting No. 2)		[2] 18	109.3
San Ramón	3,352	6	119.9
Mocha	5,021	14	78.2

[1] The moisture content of 11 of these was determined. For eight, it ranged from 12.2 to 13.8 per cent, a variation of 1.6 per cent, while for the three others it was 11.8, 10.8, and 8.4 per cent, respectively, a total variation of 5.4 per cent. This would indicate that a small allowance should be made for variation in moisture content in these comparisons of sun-dried coffee.

[2] From a count of 1,000 beans rather than from a pound.

In preparing coffee for market the skin and pulp are removed in the pulping machine, then the beans are fermented, washed, and dried, and finally the parchment and the silver skin are removed. Table 4 shows the loss in weight of each variety in the process of preparing the beans for market.

TABLE 4.—*Reduction in weight of coffee occurring during preparation for market.*

[Varieties listed according to ratio of weight of coffee cherry to weight of cleaned bean.]

Variety.	Fresh weight of 1 almud of coffee cherries.	Weight of sun-dried, cleaned beans from almud.	Weight of coffee cherries required per unit of cleaned beans.	Loss in weight from dry coffee in parchment to cleaned beans.[1]
	Pounds.	*Pounds.*		*Per cent.*
Quillou	31 3/8	8	3.9	12
Canephora	29 1/2	7 3/8	4.0	12
Congensis hybrids	29 1/16	7	4.2	13
Robusta	29 9/16	6 3/4	4.4	14
San Ramón	28 15/16	5 11/16	5.1	15
Porto Rican (Las Vegas)[2]	29 1/4	5 1/16	5.4	17
Maragogipe	29 5/8	5 7/16	5.5	17
Mocha	28 7/16	5 3/16	5.5	20
Columnaris	28 5/16	5	5.7	18
Erecta	28 5/16	4 13/16	6.3	19
Bourbon	28 1/4	4 1/2	6.3	16
Padang	29 3/16	4 7/16	6.6	18
Excelsa	28 10/16	4	7.2	26
Dewevrei (tree No. 2510)	28 5/16	3 3/4	7.5	24
Dewevrei (general)	29 1/2	3 3/4	7.9	27
Liberica	28 7/16	2 3/4	10.2	33

[1] Computed for the first four from 500 grams each of parchment coffee rather than from the almud. A sample of Porto Rican coffee as check for these ran 17 per cent.

[2] These data were obtained from a coffee plantation about 7 miles east of Mayaguez, where the land is fairly representative of the coffee region.

In the sample of Porto Rican (Las Vegas) coffee reported in Table 4 an almud of cherries gave 5 pounds 7 ounces of cleaned beans, the reduction from cherry coffee to cleaned bean being in the ratio of 5.4 to 1, a very favorable ratio, surpassed in this group by only one variety.

CHARACTERISTICS OF PORTO RICAN COFFEE.

Porto Rican coffee has been popular in Europe but is little known in the States. The following are some opinions regarding it:

For some years past France has offered the best market in Europe for Porto Rican coffee and ranks next to Cuba, which takes the bulk of the crop. * * * The current retail price for a good grade of Porto Rican coffee is 37.7 cents per pound. For purposes of comparison it may be stated that the retail prices per pound for other coffees are now as follows, in cents: St. Marc, 32.2; Malabar, 35; Santos, 31.3; Rio, 31.3; Gonaives, 31.3; Mocha, 36.8; Java, 36.8; Bourbon, 37.7. Porto Rican coffee is highly regarded in France and is frequently blended with Mocha in equal proportions.[3]

* * * The superior grades of coffee from Porto Rico now rank among the best growths produced anywhere.

[3] The coffee market of Havre, by Consul J. B. Osborne, Havre, France. Daily Cons. and Trade Rpts., Nov. 23, 1912, p. 1006.

The bean is large, uniform, and very attractive in appearance, the color ranging from a light gray-blue to a dark greenish blue. The coffee makes a particularly good roasted product, and has as heavy a body as the fanciest Colombians or Mexicans. It is not as rich in the cup as these two coffees, but it blends very satisfactorily with both of them, as well as with other growths, and in consequence is being used very much more extensively than heretofore.[9]

In a conversation with the writer, Mr. Harris, quoted above, said that Porto Rican coffee has a higher color value than any other kind.

From various published reports it would appear that the amount of caffein in coffee may range from 0 to 2.95 per cent. * * * The great majority of commercial coffees, however, have about 1.5 per cent caffein, more or less. * * * Certain coffees, as the Porto Rican, are known as mild coffees from the fact that they can be easily borne by persons who say they can not drink other coffee. As a rule (doubtless subject to exceptions), Porto Rican coffees contain less than 1 per cent of caffein, and therefore are naturally "caffein-poor."[10]

Determinations of caffein in three samples of Porto Rican coffee were supplied the author by W. J. McGee, chief, Food and Drug Inspection Station, United States Department of Agriculture, San Juan. The results are given in Table 5.

TABLE 5.—*Caffein content of three samples of Porto Rican coffee.*

Condition of coffee.	Moisture.	Caffein.	Caffein (dry basis).
	Per cent.	*Per cent.*	*Per cent.*
Green	11.03	0.98	1.12
Roasted	2.55	1.31	1.35
Do	2.63	1.30	1.34

From the data given in the above table it can readily be seen that Porto Rican coffee is comparatively low in caffein. This, coupled with its pronounced aroma and high color value, makes it a very desirable article of commerce where these characters are appreciated.

COFFEES BOTANICALLY SIMILAR TO PORTO RICAN.

Such coffees as Padang, Preanger, Menado, Kamerun, Philippine, Kona, Surinam, Guadeloupe, and Jamaican Blue Mountain so closely resemble Porto Rican in tree and fruit as to be indistinguishable from it in the field. The degree to which the quality of these coffees has been changed by change in location is not known. In 1913 samples of Porto Rican grown Padang, Pantjoer, Preanger, Guadeloupe, Blue Mountain, Erecta, Columnaris, Maragogipe, Mocha, and Porto Rican coffees were sent to S. B. Morison, of New York, who had them tested and reported on them as follows:

I had the samples tested by some of the best tasters in the city. On some things they agreed. One of them was that there is very little, if any, of the character of the seed left in the Mocha, Java, etc., that you had grown in Porto Rico. They all had no trouble in picking out the genuine Mocha and Java, which I had drawn with your samples. In all cases, as is customary in tests of this kind, we had "blinded" the cups. As to the various samples of Porto Rican coffee, the highest-grown coffees[11] were, almost without exception, the

[9] Coffee characteristics, No. 7.—Porto Rican coffee, by W. B. Harris, coffee expert, U. S. Dept. Agr. *In* Tea and Coffee Trade Jour., vol. 27, No. 5 (1914), p. 423.

[10] Scientific analyses of coffee, by O. W. Wilcox and M. J. Rentschler. Tea and Coffee Trade Jour. (1911), vol. 20, No. 1, p. 32, 33.

[11] Coffees grown at highest altitude.

best. There were one or two samples that were supposed to be high grown that did not show up the snap they ought to. As a rule, the coffees seemed to lack what we call acid or snap. That was, I should think, the one most consistent criticism of the various tasters. * * * The consensus of opinion about the samples of the coffees that you have imported from other countries to grow in Porto Rico was that generally they retain little, if any, of the quality of the original. The different tasters do not agree as to the amount retained. Some say nothing and others a distinguishable amount.

Coffees of the Arabian group at the station are growing in stiff clay soil on rather steep slopes. The soil is no better than that of the average coffee plantation, and is poorer than on many plantations; and the grove is located on an elevation just above sea level, where conditions are less favorable for Arabian coffee than is the case at higher altitudes.

Padang Coffee.

Padang coffee is highly thought of in the world's markets. In November, 1921, it was quoted at 22 to 24 cents with Porto Rican at 11½ to 15½ cents a pound.

Padang coffee is a Sumatran variety, the seed of which was received at the experiment station from the Botanic Gardens, Buitenzorg, Java. (Pl. II, fig. 1.) In general appearance both tree and bean are similar to the Porto Rican. More than 250 trees of Padang coffee have been planted at the station. Seed was planted in December, 1908, and the seedlings were transplanted to the field to an area of one-fifth acre the following August. They were 4, 6, 9, and 10 to 11 feet high, respectively, in March of 1911, 1912, 1913, and 1914. Plantings were made on both fertilized and unfertilized ground, and after the small 1911 crop. The fertilized plat for the 11-year period 1912–1922 annually yielded an average of about 3.1 liters of cherries per tree, and the unfertilized plat, approximately 2.7 liters with a maximum yield of 5.1 liters. [12]

Among the Arabian varieties the Padang bean ranks next largest after Maragogipe, considerably surpassing Porto Rican samples. (See Table 3.) Padang loses considerably in weight from cherry to cleaned bean when prepared for market, there being much less cleaned coffee per almud than in case of the Porto Rican variety. (See Table 4.)

Bourbon.

De Wildeman[13] says that Bourbon coffee, owing to its fine aroma, has always been one of the most highly esteemed sorts. (Pl. V, fig. 1.) According to Lalière,[14] it is grown in the deepest and richest soils on one-fifth of the plantations of the State of São Paulo, Brazil, and it is more exacting in its requirements than the ordinary Brazilian coffee.

In April, 1915, seed of this variety was received from J. Hill, the owner of a large coffee plantation at Santa Ana, Republic of Salvador, Central America, who wrote regarding it:

I am staking my whole future upon Bourbon. I have Bourbon out in sun at 2,000 and at 3,000 feet, and in both places it looks well, and at two years from planting out the trees have a good crop on them.

---

[12] The approximate yield of marketable coffee per tree, or per acre, arbitrarily assuming 700 trees to the acre, can easily be estimated, since there are about 4 liters of cherries of the local or similar coffee to a pound of cleaned coffee beans.

[13] Les plantes tropicales de grande culture. E. de Wildeman. 1902, p. 99.

[14] Le café (Brésil), p. 39. Amour Lalière. 1909, p. 39.

In September, 1916, 60 young trees were set in the field, where, having been fertilized, they are making good growth. In general appearance they do not differ greatly from the Porto Rican. Bourbon is an early variety, nearly half of the crop having been harvested by the end of September.

The reduction in weight from cherry to cleaned bean is greater for Bourbon than for Porto Rican (see Table 4), and the bean is smaller (see Table 3), both of which points are market disadvantages. Bourbon may be mixed with Porto Rican in marketing. The production is given in Table 6.

Pointed Bourbon.

According to Lecomte,[15] Pointed Bourbon was discovered by Leroy in Reunion, and its aroma is not so good as that of the oval-seed type of Bourbon, known in Reunion as "café du pays." Lecomte also states that this coffee is classified by some as *C. laurina*. Pointed Bourbon is mentioned by de Wildeman[16] as one of the two varieties of *C. arabica* grown in Reunion, where it is known as Café Leroy. It differs from Bourbon proper in tree, foliage, and fruit.

The tree grows very slowly, 8-year-old trees at the station being about 6 feet high. Older, fully developed trees, however, are 8 to 10 feet in height. In form, the tree is conical with a rather stiff, erect trunk. The primary lateral branches turn upward when young, the secondary laterals are numerous, and the internodes are short. Some of the internodes on the laterals may measure $1\frac{1}{4}$ inches, and the average internodal lengths for the whole branch may be only $\frac{1}{2}$ to $\frac{3}{4}$ of an inch. The leaves are elliptical, tapering to an acute base and apex, and are three times as long as broad, representative specimens ranging from 2 to $3\frac{1}{2}$ inches in length.

The cherry is comparatively small, as many as 414 being counted in a liter. The bean is pointed in shape and should not be mixed with typical Arabian coffees for marketing since it differs from them in shape. The tree, being small, yields a small crop. In 1922 8-year-old trees at the station yielded, on the average, 0.9 of a liter of cherries each.

The variety is not recommended for planting.

Erecta.

The variety Erecta was received from the Botanic Gardens, Buitenzorg, Java. (Pl. II, fig. 2.) Dr. P. J. S. Cramer, of the Department of Agriculture, Dutch East Indies, in his correspondence with the experiment station, writes, regarding this coffee:

> *C. erecta* is found from time to time in our plantations of *C. arabica typica*. It is probably a mutation repeating itself. * * * I consider it well fit for spots exposed to heavy winds. Productivity, satisfactory; growth, somewhat more vigorous than the type. Not planted on a commercial scale.

In June, 1909, 236 small Erecta trees were transferred from the nursery to their permanent place in the field. During six years, beginning with 1911, the trees attained in height approximately

[15] Le café: Culture, manipulation, production. Henri Lecomte. 1899, p. 298.
[16] Les plantes tropicales de grande culture. E. de Wildeman.

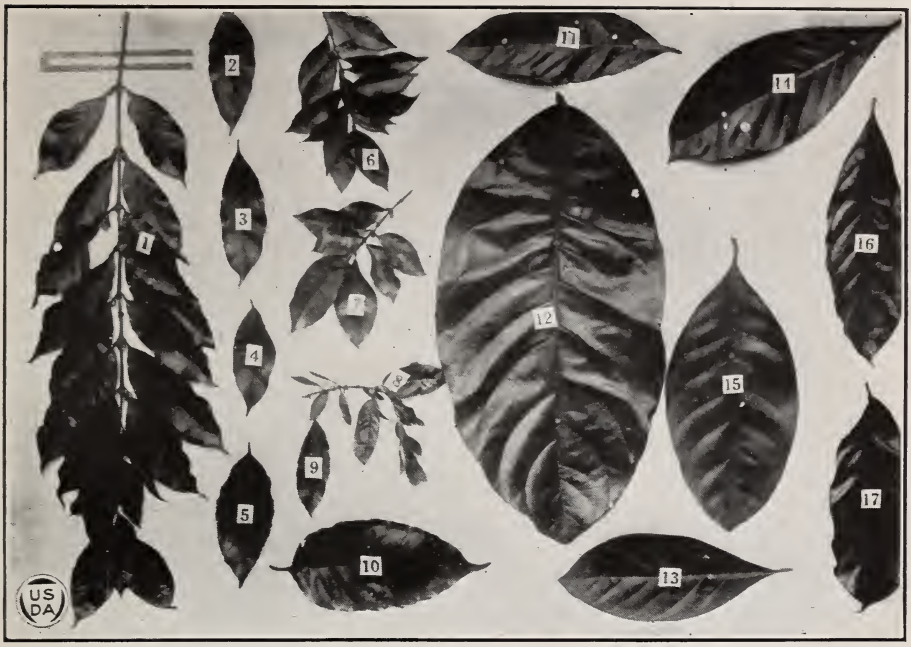

FIG. 1.—COFFEE FOLIAGE: 1, PORTO RICAN; 2, PADANG; 3, COLUMNARIS; 4, ERECTA; 5, BOURBON; 6, POINTED BOURBON; 7, SAN RAMÓN; 8, MURTA; 9, MOCHA; 10, MARAGOGIPE; 11, C. QUILLOU; 12, C. DYBOWSKII; 13, C. LIBERICA; 14, C. DEWEVREI; 15, C. EXCELSA; 16, C. CANEPHORA; 17, C. ROBUSTA.

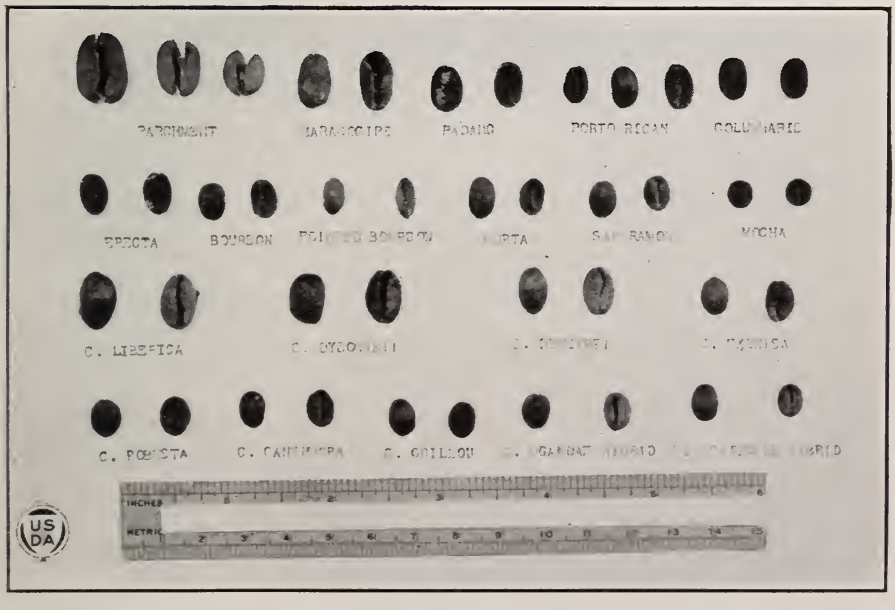

FIG. 2.—COFFEE BEANS.

FIG. 1.—PADANG COFFEE, YOUNG GROWTH.

FIG. 2.—ERECTA COFFEE.

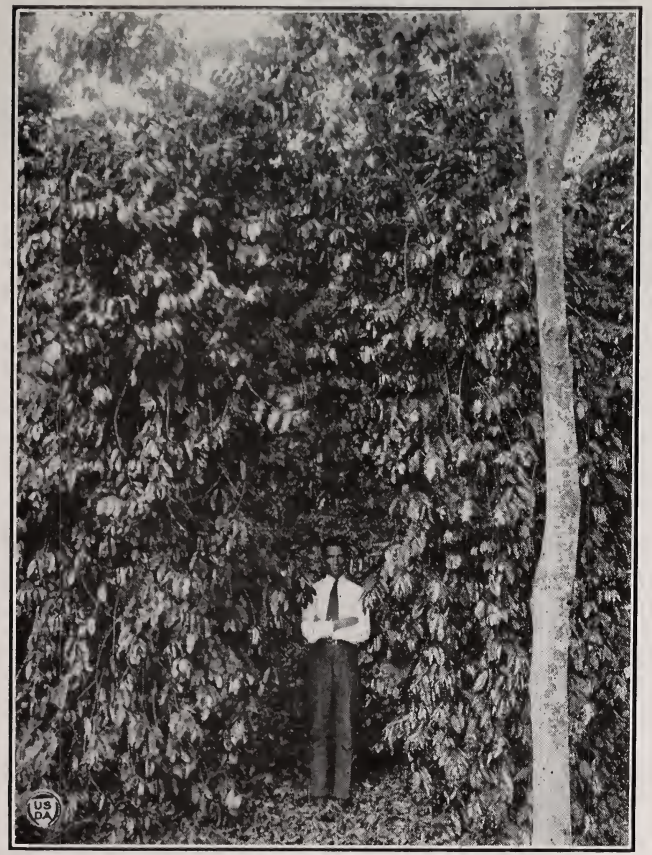

FIG. 1.—COLUMNARIS COFFEE.

FIG. 2.—MARAGOGIPE AT LEFT, AND SAN RAMÓN AT RIGHT, WITH THE INTERMEDIATE AND PROBABLE HYBRID FORM BETWEEN THE TWO.

FIG. 1.—SAN RAMÓN COFFEE AT A LITTLE LESS THAN 3 YEARS FROM SEED.

FIG. 2.—A 9-YEAR-OLD TREE OF SAN RAMÓN COFFEE.

2, 3½, 5, 6½, 8, and 10 feet, respectively. The tallest measured 17 feet, and many were 13 and 14 feet high. Though individual trees of the variety may vary considerably, Erecta differs from the local variety in its habit of rather erect growth, the more acute angle which its upward-pointing lateral branches form with the trunk or upright, and its generally smaller leaves and shorter internodes. The crop of 1911 was very small. The subsequent production per tree is shown in Table 6.

Without fertilizer Erecta produced a small crop, but with fertilizer it yielded in 1917 at this station the maximum for Arabian coffee, 8.4 liters of cherries per tree. (See Table 6.) Both cherry and bean resemble those of Porto Rican, but the reduction in weight in the ratio of 6.3 to 1, due to preparation for market, was less favorable than was true of the latter. (See Table 4.) The two may be mixed for marketing.

Its productivity in the latter part of the period recorded in Table 6 and its vigorous growth recommend it for trial.

Columnaris.

Of this coffee, received from the Botanic Gardens, Buitenzorg, Java, Doctor Cramer [17] says it is—

> A variety which is distinctive by its vigorous growth; the tree may become 25 feet high, forming a long column, covered with dense foliage. * * * A shy bearer, but recommendable for dry climates. It was discovered by a Java planter, Mr. Ottolander, on his estate Pantjoer.

In August, 1909, 160 trees, presumably 20 months from seed, were transferred from the nursery to the field. Since then a root disease, present in a part of the area planted, has steadily reduced the number of trees. Columnaris is much more vigorous than Porto Rican. In the coastal region, which is less favorable for coffee than are the uplands, its general appearance is that of coffee produced in very fertile soil at an elevation of several thousand feet. The trunk is stiff, straight, and tall; the primary laterals are very long, some being 8 feet or more in length, and on them many secondary growths are produced. Many of the branches sweep the ground, forming a dense column of foliage from the ground up, and giving distinction and beauty to the trees. (Pl. III, fig. 1.) This column-like effect is lessened after some years as the lower laterals are lost and the tall trunk bends under its heavy crops and consequent production of new uprights. The trees are large and should produce big crops. Due to their size, however, picking is difficult. The variety both blossoms and ripens later in the season than does the typical Arabian, maturing later than the Porto Rican variety by a month or more. (See Table 1.)

At the station Columnaris produced its first small crop in 1912, which was a year later than the average Arabian coffee began to bear. Another lot from seed planted in November, 1913, and set in the field in September, 1915, came into bearing in 1919, confirming the earlier indication of the tardiness of this variety in maturing. Yields, on the whole, have been satisfactory and decidedly so in the lower, more fertile section of the planting. (See Table 6.)

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[17] Coffees of the Dutch East Indies. Dr. P. J. S. Cramer. Tea and Coffee Trade Jour., vol. 35, No. 4 (1918), p. 321, 322.

TABLE 6.—*Average production of coffee cherries per tree.*

Varieties.	Date planted.	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923 [1]	Total.	Average.
		Liters.	*Liters.*	*Liters.*	*Liters.*	*Liters.*	*Liters.*	*Liters.*	*Liters.*	*Liters.*	*Liters.*	*Liters.*	*Liters.*	*Liters.*	*Liters.*
Arabian group:															
Padang (check)	1908	1.4	2.8	2.5	3.5	2.1	5.1	1.2	4.7	0.8	0.5	5.0	.....	29.6	2.7
Padang (fertilized)	1908	1.9	3.8	3.4	3.6	3.6	3.6	1.9	4.0	1.0	1.1	6.1	.....	34.0	3.1
Bourbon	1914	.....	.....	.....	.....	.....	.....	.2	1.2	1.3	4.0	2.5	.....	9.2	1.8
Erecta (check)	1907	.1	.3	.2	.5	.3	2.8	.3	1.9	.7	1.2	2.9	.....	11.2	1.0
Erecta (fertilized)	1907	.5	1.2	.8	2.0	1.6	8.4	1.6	5.8	1.9	5.0	5.2	.....	34.0	3.1
Columnaris: Less fertile section	1905	[2]	[2]	1.2	1.4	.4	[2]	[2]	[2]	1.4	1.1	1.5	.....	7.0	1.2
Columnaris: More fertile section	1905	[2]	[2]	5.3	4.6	2.9	[2]	[2]	[2]	4.7	2.7	3.4	.....	23.6	3.9
Columnaris: Entire planting	1907	.1	3.9	3.1	2.9	1.5	[3] 1.3	[3] 1.5	2.0	2.7	1.6	2.1	.....	22.7	2.1
Maragogipe	1907	.8	1.1	1.3	1.7	1.6	2.4	1.3	2.2	1.4	1.1	2.4	.....	17.3	1.6
San Ramón	1912	.....	.....	.....	.....	.3	1.0	.9	1.4	1.0	[4] .4	1.2	.....	6.2	.9
Mocha	1907	.3	.9	.4	.9	1.3	2.9	[4] .9	1.7	.2	2.2	.9	.....	12.6	1.1
Murta [5]	1909	.....	.....	.....	.6	1.0	2.0	1.1	1.4	[4] .5	.7	1.6	.....	8.9	1.1
Liberian group:															
Liberica	1912	.....	.....	.....	.....	.....	.....	1.0	[6] 3.0	[6] 4.7	3.2	5.8	3.0	20.7	3.5
Excelsa	1916	.....	.....	.....	.....	.....	.....	.....	.....	.....	.9	4.2	3.8	8.9	3.0
Dewevrei: Tree 1313	1907	.....	.....	.....	.....	[2]	[2]	[2]	[2]	29.8	8.2	33.3	1.3	72.6	18.2
Dewevrei: Tree 410	1909	.....	.....	.....	.....	[2]	[2]	7.3	16.7	12.6	31.1	19.8	22.0	109.5	18.3
Dewevrei: Tree 1007	1910	.....	.....	.....	.....	[2]	2.9	10.3	12.7	11.3	28.9	21.3	14.8	102.2	14.6
Dewevrei: Tree 104	1911	.....	.....	.....	.....	1.3	13.0	23.7	11.2	33.0	21.2	31.6	4.4	139.4	17.4
Dewevrei: Planting as whole	1911	.....	.....	.....	.....	.1	1.6	4.2	5.9	8.7	9.8	6.8	8.3	45.4	5.7
Robustoid group:															
Robusta: Planting No. 1	1914	.....	.....	.....	.....	.....	.....	.....	1.2	1.4	1.6	1.4	2.7	8.3	1.7
Robusta: Planting No. 2	1914	.....	.....	.....	.....	.....	.....	.....	.2	.7	.4	.7	1.0	3.0	.6
Robusta: Planting No. 3	1915	.....	.....	.....	.....	.....	.....	.....	.....	.2	1.7	3.2	2.6	7.7	1.9
Canephora: Planting No. 1	1914	.....	.....	.....	.....	.....	.....	.....	.8	2.5	1.9	2.3	2.5	10.0	2.0
Canephora: Planting No. 2	1915	.....	.....	.....	.....	.....	.....	.....	.....	.3	.7	1.8	.9	3.7	.9
Quillou: Planting No. 1	1914	.....	.....	.....	.....	.....	.....	.....	1.5	1.5	1.4	1.0	1.2	6.6	1.3
Quillou: Planting No. 2	1915	.....	.....	.....	.....	.....	.....	.....	.....	.6	1.7	2.2	1.6	6.1	1.5
Congensis hybrids: Planting No. 1	1915	.....	.....	.....	.....	.....	.....	.....	.....	.6	2.0	3.9	1.8	8.3	2.1
Congensis hybrids: Planting No. 2	1915	.....	.....	.....	.....	.....	.....	.....	.....	.1	.5	1.8	1.8	4.2	1.1

[1] Since the harvest season of some varieties extends through parts of two calendar years, the crop is considered as of the year in which the major part is usually harvested. (See Table 1.)

[2] Not collected separately.

[3] The yield of a few trees from seed planted in 1912–13 was included in 1917 with that from the original planting and the figures for the years 1917–18 are close approximations made from the record. No distinction was, therefore, made between the replacements and the original planting.

[4] Including, for this and subsequent years, some younger trees at this time 5 years old.

[5] In 1916 a few trees of the original planting were removed and a number of 1-year-old trees added. These are not included for yield data until 1920. It was estimated that this inclusion reduced the average for 1920 by approximately one-fourth, 26 older and 34 younger trees yielding 26.9 liters of cherries.

[6] Close approximation estimated from record.

Although the cherry was found to be slightly smaller than that of the Porto Rican in the samples compared (Table 1), the bean is large, approximating in size the Porto Rican grown at higher elevations (Table 3). An almud of cherries, reduced in weight in processing in the ratio of 5.7 to 1, gave 5 pounds of marketable beans. (Table 4.) This variety may be mixed with the Porto Rican, from which it is indistinguishable in appearance. Its cup flavor is excellent.

Columnaris is recommended for planting because of its vigorous growth, fair productivity, relatively large bean, and cup flavor.

Maragogipe.

Keable[18] states that Maragogipe was discovered in 1870 near the town of the same name in Bahia, Brazil. He also says that the variety is commercially important and has been rather extensively grown in Guatemala. Seed of this variety was received by the station from Guatemala and from Java. In September, 1909, 153 trees, presumably 20 months from seed, were set in the field. Root disease present in the soil has slowly and steadily reduced the number of trees, as in the Columnaris planting.

Maragogipe differs from typical Arabian in both foliage and internodal length. (Pl. III, fig. 2.) The internodes attain such a length as to limit their production on a given area of branch and cause the tree to present a straggling appearance. The longer internodes on the uprights may range from 7 inches to over a foot in length. As is true of the other varieties, the internodal length varies constantly. The internodal lengths measured, from base to tip, 6, 5½, 3¾, 1¾, 2, 4¼, 1½, and 2¾ inches on a representative lateral branch, immediately above a 9-inch internode. The leaves of the variety are larger than those of other varieties of Arabian coffee, some of them ranging from 7 to 10 inches in length and 3 to 4 inches in breadth. The shape also differs, being lanceolate with an upper convex surface.

The ripening season of Maragogipe is almost as late as that of Columnaris. (See Table 1.) The record of yield for the 11-year period 1912–1922 is shown in Table 6. In the last four crops are included some younger trees, more than 5 years old, which were set to replace dead trees. Not only was the average annual yield for the entire period low, being 1.6 liters of coffee cherries to a tree, but the maximum average annual yield was only 2.4 liters.

The cherries and beans of Maragogipe are the largest among the Arabian varieties. In a count of the cherries in 10 liters of each it was found that only 59 per cent as many Maragogipe cherries were required as of Porto Rican to fill the measure. The 1,000-bean weight was 70 per cent heavier for Maragogipe than for the Mayaguez sample of Porto Rican coffee. (See Table 3.) From an almud of cherries 5 pounds 7 ounces of marketable coffee was obtained, and the ratio of reduction in weight, 5.5 to 1, was very favorable. The cup flavor seems much more distinctive than is true of the other coffee varieties tested at the station. Doctor Cramer[19] says that it is "the finest coffee known; it has a highly developed, splendid flavor.

[18] Coffee. B. B. Keable. London. 1909. p. 16.
[19] Coffees of the Dutch East Indies. Dr. P. J. S. Cramer. Tea and Coffee Trade Jour., vol. 35, No. 4 (1918), p. 321.

Maragogipe is, however, a light yielder." The latter statement seems to voice the general experience.

Maragogipe is not recommended for general planting because of its low production.

San Ramón.

Seed of San Ramón, received from J. Hill, Santa Ana, Salvador, was planted in the nursery in February, 1913, and 321 seedlings were transplanted to the field in August, 1914. Regarding the variety, Mr. Hill, in his correspondence with the station, writes as follows:

> Some call this variety "San Lorenzo," but the right name is San Ramón, and it originated in one of these Central American Republics.
>
> These trees seem made by nature to stand a very exposed windy outlook as they are strong and stiff and hardly bend under a high wind. * * * This San Ramón does well where the winds make the cultivation of Arabica or Maragogipe difficult, and it seems to do well in other places where the Arabica has been growing for years and has got played out. The San Ramón, being a small tree, is planted closer than the Arabica, say 2 by 2 yards, and its production per acre is about 600 pounds clean bean. The quality in the cup is all right.

The slow growth and dwarf habit of San Ramón were shown by measurements of average height taken annually at the station. At time of setting the trees averaged 19 inches, and thereafter annually 27, 39, 48, 53, 61, and 68 inches, which was an increase in average height of never more than a foot a year. (Pl. IV, fig. 1.) Although there is a rather wide range in variation in the station plantings, representative trees are dwarf and bear short internodes, permitting of the production of a large number of cherries on a comparatively short length of branch. (Pl. IV, fig. 2.) A 15-inch branch may carry 15 nodes or even a much larger number. The leaves are broadly elliptical in outline, very dark green in color, and are comparatively flat, being only slightly wavy. The base and apex are obtuse, except for the acute tip of the former. Representative leaves range in length from $2\frac{1}{4}$ to 5 inches, and in breadth from 1 to $2\frac{1}{2}$ inches, 4 by $1\frac{5}{8}$ being a typical size.

This variety comes into bearing very young. In August, 1915, one year from setting and two and one-half years from planting the seed, 17 per cent of the trees bore fruit. This percentage is increased as much again if only half of the planting receiving greater care in transplanting is considered.[20]

In 1916, 90 per cent of the trees were producing. San Ramón is one of the three late-season varieties of the Arabian group, more than one-third of the crop maturing in December and January. In addition to ripening late, this variety has a long bearing season, 14 per cent of the yield having been picked in August and September. Table 6 shows the average production per tree, which, during seven years, amounted to 0.9 of a liter of coffee cherries. Although this yield is small in comparison with that of other varieties, it is large in proportion to the size of the tree. The dwarf form is much easier to harvest than is the typical Arabian. Owing to its stocky form and short internodes, the trees may be set 4 to 5 by 6 feet apart. The uneven coloring of the ripening cherry is characteristic of San Ramón, the surface above the line of division between the two beans

[20] Porto Rico Sta. Bul. 22, Effect of different methods of transplanting coffee, p. 8.

turning deep red while that over the convex face of the bean is still green. The cherry is considerably smaller than the Porto Rican, 44 per cent more San Ramón cherries being required to fill a liter measure than of Porto Rican grown at Mayaguez. The difference in size of bean is less pronounced, the long dimension of San Ramón being shorter than that of the Porto Rican. This difference is not sufficient to warrant any distinction in picking or marketing, however. One thousand moisture-free San Ramón beans were found to weigh 86 per cent as much as the Porto Rican (Mayaguez). When equal measures of the two were compared, San Ramón yielded the most marketable coffee. An almud of San Ramón coffee gave the highest yield of marketable beans, 5 pounds 11 ounces, the most favorable ratio of reduction in weight from cherry to bean, 5.1 to 1, and the smallest loss in weight, 15 per cent, through the removal of the parchment, of any of the Arabian group tested. (See Table 4.)

San Ramón is recommended for trial in exposed situations where the typical Arabian coffee does not do so well. Its stocky growth facilitates harvesting, but the small size of the beans is a disadvantage in marketing, as large beans sell at better prices.

In the San Ramón planting at the station two trees are apparently crosses between San Ramón and Maragogipe. In form these trees are like the San Ramón, having short internodes and dwarf, stocky development, while in size the foliage and fruit closely approach Maragogipe. (Pl. III, fig. 2.) Some of the leaves are intermediate between the two varieties in shape. The bean is fully as broad as that of Maragogipe, but somewhat shorter. It is, however, considerably larger than the other Arabian varieties at the station. The fact that this cross embodies a valuable quality from each hypothetical parent suggests the advisability of planting a few alternating rows of each parent in an isolated location and emasculating all flowers of San Ramón prior to opening, in order that first generation crosses in quantity may be secured with comparatively little trouble.

Mocha.

A little more than 200 years ago practically all the coffee exported from Arabia was shipped through the port of Mocha for exportation, whence came the name "Mocha coffee." The production of genuine Mocha is extremely limited and relatively insignificant in quantity, but, owing to the establishment of the name as a trade term, considerable quantities of coffee from various sources have been sold as Mocha. Mocha coffee brought higher retail prices than any other sort on the New York market on April 11, 1922.[21] Mocha coffee is quite distinct from typical Arabian. Doctor Cramer[22] suggests that it is "perhaps a distinct species (*C. mokka*)," although he classes it as a variety of *C. arabica*, of which usually it is considered a subspecies.

Seed of Mocha coffee was received by the station from Java, and in September, 1909, 293 young trees, 12 to 18 inches high and presumably 18 to 20 months old, were set in the field. Two years later

[21] Prices current: Wholesale and retail. Tea and Coffee Trade Jour., vol. 42, No. 4, p. 550. (1922.)

[22] Coffees of the Dutch East Indies. Dr. P. J. S. Cramer. Tea and Coffee Trade Jour., vol. 35, No. 4, p. 321.

they averaged 35 inches in height, and for the three following years 52, 68, and 82 inches, respectively. At this time, five years from setting, the 16 tallest trees were 10 to 13 feet high.

In general appearance the tree differs noticeably from the typical Arabian, due to its short internodes and much smaller fruit and foliage. In some instances the entire branch ranges from two-thirds of an inch to 1½ inches in average internodal length, while individual internodes measure one-fourth of an inch to 3 inches. The leaf is elliptical in shape with acute apex and base. In length it varies from 2½ to 4 inches, and in breadth from three-fourths of an inch to 1½ inches,

The Mocha crop at the station matures in a comparatively short season, 89 per cent having been harvested in September and October. For the period as a whole, the crop was the earliest harvested of the varieties compared. The maximum average annual yield was 2.9 liters of coffee cherries per tree, and the average annual yield for the period, 1.1 liters. The cherries are the smallest of any in the Arabian group, four samples of 1 liter each containing between 503 and 582 cherries, with an average of 543. An almud of cherries weighing 28 pounds 7 ounces gave 5 pounds 3 ounces of marketable coffee, a reduction in weight in the ratio of 5.5 to 1. A pound of this lot contained 5,021 beans while a pound from the crop of another season contained 6,273 beans. In a comparison of samples of 1,000 moisture-free beans, the Porto Rican (Mayaguez) bean was found to be one and three-fourths, and the Maragogipe three times as heavy as Mocha. (See Table 3.) The flat face of the Mocha is more rounded in outline than is the Arabian type. Representative beans grown at the station measure from 5 to 8 millimeters long by 5 to 6 millimeters broad, the breadth sometimes equaling the length in the smaller ones. In cup quality, Mocha is excellent.

The variety is not recommended for commercial planting for the following reasons: Although it is typical Mocha coffee and altogether distinct from other coffees, it can not be marketed as Mocha under the existing laws. Moreover, while the quality is excellent, the cherries are so small that the number contained in a given measure is nearly double that of Porto Rican coffee, and this alone would double the cost and difficulty of picking.

Murta.

Lalière [23] states that Murta is characterized as a degenerate variation of Bourbon and is grown in Brazil. Graham [24] lists it last of the six principal varieties grown in the State of São Paulo. At the station it has proved to be a mongrel,[25] approximately half the seedlings being of the Murta type, the others ranging from small dwarfs with many upright branches resembling tiny green rosettes to the ordinary Arabian type. (Pl. V, fig. 2.) The fully developed Murta tree is 7 to 9 feet in height, with a spread of about 4 feet. (Pl. VI, fig. 1.) The internodes are short, those of a representative tree measuring little less than 1¼ inches for the upright and about five-

[23] Le Café (Brésil). Amour Lalière. 1909, p. 40.
[24] Coffee: Production, trade, and consumption by countries. U. S. Dept. Agr. Bur. Statistics Bul. 79, p. 14.
[25] Porto Rico Sta. Rpt. 1916, p. 22.

eighths of an inch for the laterals. The leaves are elliptical, rather flat and small, representative specimens ranging from 1 inch to 3¼ inches in length by one-fourth inch to $1\frac{7}{16}$ inches in breadth.

In September, 1910, 50 plants of Murta, from seed planted in the previous winter, were set in the field together with 13 plants of the Arabian type springing from Murta. Three years later trees of the Arabian type were bearing very well, while the Murta trees bore too light a crop to pick. In 1914, 11 of the 12 surviving Arabian type trees were fruiting, and only 10 of the 47 Murta trees. Of these 10, the most productive bore less than 0.5 of a liter of cherries, the second only about 0.2 of a liter, and the others only 1 or 2 cherries. The Murta yields in subsequent years are given in Table 6. The individual production was small.

The ripening season for Murta is about the same as for the native coffee. Both cherry and bean of the two coffees are indistinguishable in size and appearance. Murta is good in cup quality. Lateness in coming into bearing and low yields are disadvantages, but ease of picking, due to the small size of the tree, is in favor of this variety. A planting distance of 4 by 6 feet is recommended for Murta in order that through close planting the acre yield may be increased sufficiently for the variety to compare favorably with other varieties.

LIBERIAN GROUP.

Generally, Liberian coffee is considered inferior in quality to Arabian, and the demand for it is limited. In growth this group is larger than the Arabian, the plants assuming the proportions and appearance of trees rather than of shrubs. Harvesting is rather difficult owing to the height attained by the trees. Liberian coffee can be grown with or without shade in regions where Arabian coffee requires shade. The leaves are large and stiff, and due presumably to their rather leathery texture, are less susceptible to attacks of the leaf miner than are coffees of the other two groups.[26] In all species of the Liberian group, Excelsa excepted, the fruit is large and the pulp thick and firm, features which make removal of the seed difficult.

Liberica.

Of coffee in Liberia, Graham[27] writes as follows:

> Coffee grown in this country, known as *Coffea liberica*, is cultivated very successfully in hot, moist lowlands or on hills of no great altitude. * * * The trees in a wild state often attain a height of from 30 to 40 feet. The berry is * * * from 30 to 40 per cent stronger in flavor, hence it is used to a large extent in blending with mild coffees.

Cramer[28] observes that—

> Well-developed trees may measure 50 feet in height. * * * It is better suited to lower altitudes; regions near sea level are the best. * * * The fruit is large, the largest known in coffee. * * * The produce is esteemed for the strength of its taste, having little flavor but much "body," and it is therefore used for blends with highly flavored qualities but lacking body. * * * Liberian coffee has been practically given up here [Java].

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[26] The leaf miner causes large losses in certain sections of the island.

[27] Coffee: Production, trade, and consumption, by countries. U. S. Dept. Agr. Bur. Statistics Bul. 79, p. 99.

[28] Coffees of the Dutch East Indies. Dr. P. J. S. Cramer. Tea and Coffee Trade Jour., vol. 36, No. 1, p. 23, 24. (1919.)

The Liberian coffee at the station was derived from various sources. With the exception of three trees, set in 1910 when small, the main planting of 77 trees is from seed sown between October, 1911, and January, 1912. In July, 1913, the trees were transplanted to the field, and each July thereafter annual measurements of their height were made. The trees transplanted in 1913 averaged 13¼ feet in height in 1919. The maximum height in 1922 was 20½ feet. The tallest of the three trees set out in 1913 was 26½ feet in July, 1922.

Trees of the Liberian group are of upright rather than of spreading habit, with stiff, straight trunks. The internodal length, while extremely variable, is greater than that in the Arabian group, the longer internodes on uprights even exceeding a foot in length. The leaves also are larger, oval or elliptical in shape, typical specimens measuring 6 to 12 inches in length by 2¼ to 6½ inches in breadth, and are stiff and leathery in texture. Van Zwaluwenburg [29] states that "some varieties of coffee seem to be practically immune to miner injury due to the thickness of their leaves; among these are the Liberian coffee and several other species belonging to the same group." A miner may enter a leaf, but it will hardly make much headway. The flowers are large and white, and have six to eight petals.

Most of the crop of this variety in Porto Rico is harvested from December to March, inclusive, with the heaviest ripening in January, with February second. At five years from seed about three-eighths of the trees were producing a few cherries, but the total yield was negligible. During the sixth year three-fourths of the trees were producing. The average yield for the planting, in fresh cherries per tree, is given in Table 6.

In color, the cherry is finely striped in dull red and light yellow (straw), with the red predominating. The disk is russet and in some specimens very broad and prominent. The cherries are borne singly and in small clusters rather than in densely crowded clusters like those of Excelsa or the Robusta group. The skin and pulp differ from those of the Arabian in that they are very thick, stiff, contain less juice, and form a much larger proportion of the fruit. In an almud freshly pulped the ratio by weight of pulp to coffee in parchment was a little over 8 to 5. The parchment is more woody and darker in color than that of the Arabian, and while the reduction in weight through removal of the parchment of the Arabian may run from 15 to 20 per cent, it amounted to 33 per cent in a sample of Liberian, which was the heaviest reduction in any of the coffees compared.

There is a wide range in size of Liberian cherries. A liter of cherries selected for size was found to contain 68 large specimens, or 214 small ones. Two liters were found to contain 132 and 141, respectively, of unselected cherries. An almud of cherries which weighed 28 pounds 1 ounce before pulping, gave 4 pounds 1 ounce of dry coffee in parchment. After the removal of the parchment there remained only 2 pounds 12 ounces of marketable coffee, the total reduction in weight being 10.2 to 1, which was the most un-

[29] Insects affecting coffee in Porto Rico. R. H. Van Zwaluwenburg. Jour. Econ. Ent., vol. 10, No. 6 (1917), p. 514.

FIG. 1.—BOURBON COFFEE.

FIG. 2.—HETEROGENEOUS FORMS FOUND IN SEEDLINGS OF MURTA COFFEE.

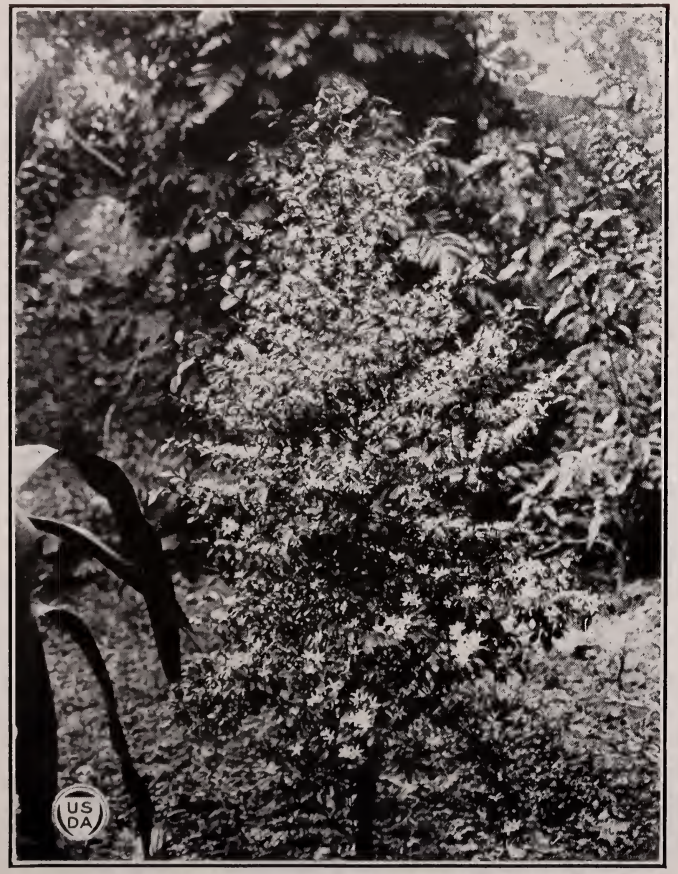

FIG. 1.—MATURE TREE OF MURTA COFFEE IN BLOSSOM.

FIG. 2.—COFFEA DEWEVREI; TREE NO. 104 AT 5 YEARS FROM SEED.

FIG. 1.—COFFEA DEWEVREI; TREE NO. 1007, AFTER 8 LITERS OF CHERRIES HAD JUST BEEN PICKED FROM IT.

FIG. 2.—COFFEA EXCELSA WITH FRUIT.

FIG. 1.—COFFEA EXCELSA AT A LITTLE MORE THAN 6 YEARS FROM PLANTING SEED.

FIG. 2.—COFFEA ROBUSTA AT 3½ YEARS FROM PLANTING SEED.

favorable ratio shown by any variety tested. A representative bean is 12 to 13 millimeters long by 8 to 9 millimeters broad, fairly plump, with the concave face furrowed with a broadly open suture. One thousand Liberica beans were found to weigh more than an equal number of Maragogipe, the largest of the Arabian group. The bean is of a greenish straw color, and is wrapped in silver skin of glistening clay color. Two samples of marketable coffee were found to contain 1,612 and 1,786 beans per pound, respectively.

When the very heavy reduction in weight from cherry to marketable bean is considered in connection with the individual yield, and also the wider spacing required for trees of this species, it will be seen that the harvesting is costly and the yield per acre very light. Considering further the difficulty of harvesting, due to height, if the trees are untopped, and of pulping, there is little to warrant the planting of this variety.

Excelsa.

Excelsa is said [30] to have been discovered in 1905 by Aug. Chevalier in West Africa, in the region of the Chari River, not far from Lake Tchad. In writing of it in Java, Doctor Cramer says that it is not particular as to soil, and is suited to the same climate as is Liberian, but will do very well also in higher altitudes. He states that at Bangelan the best field produces 760 to 1,500 pounds per acre. Doctor Cramer pronounces its quality good and its growth vigorous, and asserts that it is one of the best kinds to grow for produce.

The first Excelsa coffee in Porto Rico was received by the station from the French Government in 1906. Two inarched plants, severed from this tree in December, 1912, and set in the field in May, 1913, were 22½ and 23½ feet high in June, 1922. The trees began to bear in 1917 and made an average yield of 13 liters of cherries each in the season of 1921. Fifty-four trees, the seed of which was received from Bangelan, Java, in November and December, 1915, were set in the field in August and September, 1917. These have made very vigorous growth (Pl. VIII, fig. 1), attaining an average height of 10.9 feet in June, 1922, and having an average spread of 9.1 feet. At this time the height of the tallest tree was 18½ feet and its spread 10½ feet. The spread of the broadest tree was 14 feet with a corresponding height of 11¾ feet. The only pruning given these trees up to this time consisted in the removal of suckers. Doctor Cramer, however, who has had extensive experience with Excelsa coffee in Java, where hundreds of acres are planted to it, in his correspondence with the office, advises topping at 3 or 4 feet when young in order to develop the lower primary laterals. When these have attained considerable size an upright is allowed to develop and continue the growth of the tree to a height of 12 feet. It is again topped and thereafter kept at this height to permit of picking from ladders. Doctor Cramer also advises the removal of all suckers, not only from the main trunk, but likewise from the primary laterals. Topping is necessary for all members of the Liberian group to facilitate picking.

[30] Coffees of the Dutch East Indies. Dr. P. J. S. Cramer. Tea and Coffee Trade Jour., vol. 36, No. 1, p. 25. (1919.)

In general appearance Excelsa somewhat resembles Liberian, but there are very decided differences in foliage, flower, and fruit. The young tree is much more spreading, and the leaves are larger, oval, and more rounded than those of Liberian, though of similar stiff texture. Representative leaves are 8 to 12 inches in length and 4 to 6 inches in breadth, a typical specimen measuring about 9¾ by 5 inches. On laterals representative internodal lengths are 2 to 5 inches. The large, white flowers have only four to six petals, like the Arabian, but are unlike it in blossoming season, heavy blossomings appearing in summer or autumn when Arabian coffee is not in flower, and the trees at times carrying simultaneously buds, blossoms, and immature and mature fruit. The fruits are thickly clustered, as many as 35 and 40 appearing at a single node. (Pl. VII, fig. 2.) They are much smaller than those of Liberian coffee, and appear solid colored. Upon examination, however, there is found a fine striping in nopal red to maroon, and in some specimens, alternate pale yellow and red. The disk, which is very variable in size and often only slightly russeted, is not so prominent as is that of Liberian coffee, but it is more prominent than is that of Arabian.

Of the 54 trees set in 1917, 1 died, 2 fruited in 1920, 41 in 1921, and 50 in 1922. The major part of the crop has ripened in the three months of spring. Since the Arabian crop ripens in the fall, the production of both on the same plantation would offer certain advantages in regard to labor. Another advantage in planting Excelsa is that the cherries, in common with the other members of the Liberian group, do not fall on ripening. Pickings at the station have been made at monthly intervals. The ripening season is shown in Table 1, and the yield in Table 6.

Seven samples were found to contain between 369 and 455 cherries, with an average of 410 cherries per liter, showing them to be materially smaller than those of the Porto Rican. The pulp is firmer than that of Arabian coffee, but unlike Liberian in that it is rather thin and therefore pulped with greater ease. Five almuds of freshly picked cherries ranged in weight from 28 pounds 3 ounces to 28 pounds 11 ounces. Two almuds of cherries picked at different times in the season checked very closely, weighing when fresh 28 pounds 10 ounces and 28 pounds 11 ounces, respectively; and giving, after pulping and drying, 4 pounds of cleaned beans each. Each lot showed a reduction in weight of 26 per cent on removal of parchment and a total reduction in weight from cherry to marketable bean in the ratio of 7.2 to 1. One thousand moisture-free beans from each almud weighed 153 and 154.1 grams, respectively.

In weight, the bean does not differ greatly from the Porto Rican, there being both a greater and a less number per pound than was found in the two samples of Porto Rican given in Table 3. A representative size is 9 or 10 millimeters long by 7 or 8 millimeters broad. The silver skin is of a pale brownish color and the bean is straw-colored or yellow. A considerable portion of the silver skin adheres to the beans, giving them a rough and uneven appearance, unless they are rapidly dried by artificial heat, and a fragment of the parchment is likely to be held in the deep sutures when being broken off. Since the appearance of the bean is totally different from that of the Porto Rican, the two should not be mixed for marketing.

Excelsa is the most promising of the Liberian group of coffees so far tested at the station. Its good cup quality, vigorous growth, comparatively low (for the Liberian group) ratio of reduction in weight, indications of productivity, and resistance to the leaf miner recommend it for trial, especially in localities which suffer from ravages of this pest.

DEWEVREI.

This species is indigenous in African Congo, whence seed was received by the experiment station in September, 1911. The station planting shows an extremely wide variation in type, and suggests a heterogeneous collection of several varieties. Individual trees differ in size of foliage; in color of blossoms, some being white and others pale pink; in number of petals, flowers having five, six, seven, or as many as eight petals; in size, shape, and color of cherry; in size, protrusion, or flatness of navel; in thickness of pulp; in color of silver skin; and in shape of bean.

In August, 1913, 56 trees were transplanted from the nursery to the field, some of the trees then being 3 feet high. Two years later the trees had attained an average height of $5\frac{1}{2}$ feet, and annually thereafter for five years they were $7\frac{3}{4}$, $9\frac{1}{2}$, $11\frac{1}{4}$, and $14\frac{3}{4}$ feet high, respectively. In another two years the average height was $17\frac{1}{2}$ feet, and the tallest trees were about 25 feet high. (Pl. VI, fig. 2.) Fully developed specimens are said to attain a height of 50 feet. Some unpruned trees make a tall columnar growth and develop rather frail lateral branches, while others spread into pyramidal form and develop very heavy, thick laterals. In plantation practice it is advisable to limit the height to 12 feet in order to facilitate picking.

These trees, like the others of the Liberian group, have dark green, leathery leaves ranging from 9 to 14 inches in length by $3\frac{1}{2}$ to 6 inches in breadth, the length usually being $2\frac{1}{2}$, and in some instances 3 times the breadth. In general, the leaf shape is subspatulate with acuminate base and acute to obtuse apex, and has a slightly wavy surface. The foliage is dense, the tree forming a close screen.

On most of the trees the cherries are more closely clustered and their pulp is thinner than is the case with Liberian. Counts of 11 samples of cherries, picked from eight trees individually, showed between 208 and 329 specimens per liter, with an average of 263 cherries. (Pl. VII, fig. 1.) In color scheme the cherries are reddish-yellow, producing in some a solid effect, or yellow striped with red. The individuals differ widely in their season of ripening, and mature cherries may be found on some trees during almost any month of the year. The major part of the crop has ripened in the winter months at the station.

The trees came into bearing in the winter of 1915–16. The average yield for the planting as a whole and the individual yield of four of the best trees for that period, and for subsequent years, is given in Table 6. On various occasions more than an almud of cherries has been picked from a single tree at one picking. The crops of 1920, 1921, and 1922, taken together, showed an average annual yield of over half an almud per tree for 38 per cent of the trees.

The average bean is intermediate in size between that of the Maragogipe and the Padang. The ratio of reduction in weight for the

two almuds on which data are given in Table 4 was less favorable than for Excelsa, the two almuds of Dewevrei each giving 3 pounds 12 ounces of marketable coffee. In this planting there are some worthless trees, together with a number of notably vigorous and productive trees of a much more desirable type than is the ordinary Liberian coffee.

Where such variation is exhibited among trees it would seem advisable to practice shield budding of the more desirable strains for further propagation. This is a simple process but is not practiced locally. The trees should be set at planting distances of about 12 by 12 feet and be topped at a height of 12 feet.

Other Members of the Liberian Group.

Coffea abeokutæ.—In the station plantings there are a few trees of this species which came from St. Lucia, West Indies. These are vigorous and in foliage, fruit, and manner of growth are similar to *C. liberica.* The cherries are large, 99 having been found in a liter, and the pulp is thick. Being very inferior to *C. excelsa* and to many individuals in the planting of *C. dewevrei*, this species is not recommended for trial.

Coffea dybowskii.—Seed from a tree of this species that was growing surrounded by trees of *C. excelsa*, and thought to contain possibly some hybrids of the two, was received from the Java Experiment Station in the years 1916–1918. Trees of the earlier importation are just coming into bearing. They look promising, but it is too soon yet to predict their merits. In growth they are very vigorous, and in general appearance are suggestive of a magnified *C. excelsa*, with their longer internodes, larger leaves, and larger closely clustered cherries. The internodes on laterals range from 3 to 9 or more inches in length, 4 to 7 being a representative length. The leaves are oval, of heavy texture, and the largest of any found in the station plantings, measuring 6 by 14 to 9 by 20 inches. The flowers are five-petaled and $1\frac{3}{4}$ inches across. The cherries are very large, averaging 185 per liter in two lots taken from one tree, and they have a rather thick pulp.

Robustoid Group.

Robusta coffee, with its related species, has come into prominence only within recent years. Being considered poor in cup quality, this coffee has been rather reluctantly purchased by American dealers. It has been rather extensively planted in the East Indies because of its heavy production. In growth the tree is intermediate between that of the other two groups. Its ripening season in Porto Rico is distinct from that of the Arabian coffee, the crop beginning to mature toward the end of the Arabian harvest. The pulp is very thin and an almud of Robusta cherries will therefore contain more marketable coffee than is true of either Arabian or Liberian. The ripe cherries do not drop readily, and pickings may be made every four weeks instead of every two, as is the local practice. The growing of this coffee for export is not recommended, but it may serve to furnish a low-priced article to that part of the local trade which prefers a cheap rather than a high-priced coffee of good quality.

Robusta coffee was discovered in the Congo by Emil Laurent in 1898.[31] It was put on the market under the name of *Coffea robusta* by a horticultural firm in Brussels. Doctor Cramer states[32] that young seedlings were imported in 1900 from Brussels into Java, and that what is known as Robusta coffee is probably a group of coffees of different varieties rather than a pure species. The rapidity with which Robusta coffee has been taken up by the Javan planters has been phenomenal. Within 20 years of its introduction, 298,774 acres, or 83.5 per cent, of the total area in coffee in the Dutch East Indies were planted to Robusta, while only 19,780 acres, or 5.5 per cent, were in Arabian coffee.[33]

Of Robusta coffee in Java, Doctor Cramer writes as follows:[34]

> Robusta is marked by rapid growth, early fruiting and high productivity, * * * likes wet climates, especially those with regularly divided rains. It is grown in Java from sea level up to more than 3,000 feet and in Sumatra at even higher altitudes. The general altitude for it may be put at 1,000 to 3,000 feet above sea level. * * * Robusta does not like wind, and suffers especially from continuously dry winds; it requires shade, at least in higher altitudes. * * * Under favorable conditions the crop may be 1,520 pounds per acre. The average may be estimated at 750 to 1,150 pounds per acre. * * * The crop comes in all the year round in climates with regularly distributed rainfall; in regions with a sharply marked dry season the crop lasts three to four months, according to the rains.
>
> * * * Robusta and allied species are not so appreciated as other kinds. They rank a little under good average Santos. To clean the beans from the silver skin artificial drying is necessary. The skin may be removed by drying in the sun and washing, but. then, second quality is obtained. Robusta is a bulk produce, not, as Liberian and Java coffee, a fancy quality.

At the station robustoid coffees have been received under such names as *Coffea robusta*, *Coffea quillou*, *Coffea canephora*, *Coffea laurentii*, and *Coffea ungandæ hybrid*. Judging from the plantings at the station, a number of specific names have been applied to a group of closely related coffees which were propagated by seed and will likely continue to cross. In some instances differences can be seen; in others, the difference in name is the only dissimilarity. All, however, would be classed in the group known as Robusta coffee. Here, also, are included the station plantings from seed received as *Coffea congensis*, as explained later under that heading.

Robusta.

Especially selected seed of the best trees of Robusta coffee was received in October, 1914, and November, 1915, from the experiment station at Buitenzorg, Java Two plantings of the first lot of seed were set in September, 1915, one of 114 trees and the other of 28 trees, and a third planting of 60 trees of the second lot of seed was set in August, 1917. A few trees of each lot were lost within the period reported.

At a year from setting the tallest trees in the first planting were 50 inches high, but the average height was only 30 inches. By the

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[31] Coffee robusta. W. J. Gallagher. Dept. Agr. Federated Malay States Bul. 7, p. 1. (1910.)

[32] Coffees of the Dutch East Indies. Dr. P. J. S. Cramer. Tea and Coffee Trade Jour. (1918), vol. 35, No. 5, p. 417.

[33] Coffee in the East Indies. J. S. Fowler. Tea and Coffee Trade Jour. (1920), vol. 39, No. 3, p. 299.

[34] Coffees of the Dutch East Indies. Dr. P. J. S. Cramer. Tea and Coffee Trade Jour. (1918), vol. 35, No. 5, p. 417.

following September, or two years from setting, the maximum height attained was 119 inches, the average height was 59 inches, and a number of trees were over 7 feet. (Pl. VIII, fig. 2.) Further measurements were not made as topping at about 8 feet was begun within the year. Unless they are topped the trees will soon make such vigorous growth as to render picking difficult. The lateral branches are rather delicate. Representative lengths are 2½ to 4½ feet, although some exceed this. The internodes on laterals range in length from 2 to 6 or more inches, with an average of 3 or 4 inches. The leaves of the various individuals vary somewhat in shape, some being oval with obtuse base and apex having acuminate tip, and others being elliptical with acute base and apex. In length they may range from 6 to 12 inches, but generally are 7 to 10 inches. The length ranges from less than twice to nearly three times the breadth. The leaf texture is not so heavy as in the Liberian group, and the leaves are subject to attacks by the leaf miner.

The blossoms are white, five or six petaled, and from 1¼ to 1½ inches across. They appear at irregular intervals, and may be seen on the trees simultaneously with green and mature cherries. (Pl. X, fig. 2.)

The ripening season for the three plantings is given in Table 1. In common with the other members of this group the crop began to ripen in October, but ripened mainly in the winter months, nearly half maturing in January and the rest in the spring. Only a negligible quantity of cherries ripened in the fourth year from seed. The yields, which are shown in Table 6, have been surprisingly low for a coffee celebrated elsewhere for its productivity. The cherries are closely clustered, there being 15 to 30 or more at a node. (Pl. IX, fig. 2.) When ripe they are blood red, some being of solid color and others finely striped in dark and light red. Striping is less conspicuous when the cherries are very ripe. Occasionally the navel is flat, but more frequently it protrudes, and the pulp is very thin. The cherry is smaller than that of the Arabian coffee, representative specimens being 14 millimeters long, 13 millimeters in the diameter at right angles to the flat faces of the beans, and 10 to 11 millimeters in the other diameter. Five samples showed between 528 and 630 cherries per liter with an average of 564. Two almuds of freshly picked Robusta cherries weighed 28 pounds 11 ounces and 29 pounds 9 ounces, respectively. The latter gave 6 pounds 12 ounces of cleaned marketable beans, a reduction in weight in the ratio of 4.4 to 1. Two samples were found to contain 2,726 and 2,736 beans per pound, respectively, showing the beans to approximate the Porto Rican coffee in weight, though it differs from the latter in its more rounded form. The silver skin is brownish and rough in appearance, and adheres closely to the bean. It does not clean off readily after slow drying in the sun, but is effectively removed when rapidly dried by artificial heat. The bean does not present an attractive appearance unless the silver skin is thoroughly removed.

Canephora.

Considerable variation between individuals is found in the station plantings of *Coffea canephora*. The range is from the type showing narrower leaves or more flattened cherries than those of the typical *C. robusta* to others which are wholly indistinguishable from *C. robusta* in habit, foliage, and appearance of cherry. This is perhaps

accounted for by the crossing of two closely related strains. Leaves may vary from 7½ or 9 to 10 or 12 inches in length, and from 2¾ or 3 to 4½ and 6 inches in breadth. Usually the cherries are striped, but some appear solid in color, being a lighter red and slightly smaller than those of *C. robusta.*

One tree, received from the French Government in 1906, has fruited heavily in some seasons, giving a maximum yield of 14 liters of cherries at a single picking. (Pl. XI, fig. 1.) Two plantings have been made of *C. canephora*, one of 24 trees from seed sown in the last quarter of 1914 and the other of 60 trees from seed sown a year later. Seed of the latter and part of the former came from the Java Experiment Station. The yield of the two plantings is shown in Table 6.

An almud of cherries, weighing 29 pounds at picking, gave 6 pounds 6 ounces of marketable beans, or a reduction in weight in the ratio of 4.5 to 1. Another almud picked in a different season, weighing 29 pounds 8 ounces, gave 7 pounds 6 ounces of marketable beans, or a reduction in weight in the ratio of 4 to 1. Counts of six samples showed between 552 and 704 cherries per liter, with an average of 654. Twenty-five unselected beans from a large and representative lot of *C. robusta* and *C. canephora* coffee were measured for purposes of comparison. In length, breadth, and thickness, *C. robusta* averaged 8.7, 7, and 4.4 millimeters respectively, and *C. canephora*, 8.2, 6.6, and 4.2 millimeters respectively, showing the latter to be the smaller in each of the three dimensions. As is true of Robusta, the silver skin adheres closely to the seed of *C. canephora*, but it is more uniformly brown in color than is the former.

Laurentii.

One tree of *Coffea laurentii* (S. P. I. No. 28080), which is cultivated in the Congo Free State, Africa, and known also as *C. robusta*, grows at the station. (Pl. X, fig. 1.) It has not been observed to differ from the other Robusta coffees, and has fruited very heavily, often producing half an almud of cherries in a season. In one season it produced 19.4 liters (a little less than an almud) of cherries. Counts of three samples showed 581, 633, and 645 cherries per liter, respectively.

Quillou.

Coffea quillou was imported into Java from the French Congo by the Java Experiment Station, which later supplied the Porto Rico station with seed. Doctor Cramer[35] states that under favorable circumstances *C. quillou* coffee produces more than other varieties, yielding in good years 2,500 pounds of merchantable coffee to the acre.

Two plantings have been made at the Porto Rico station, the first of 47 trees from seed received and planted in October, 1914, and set in the field in September, 1915, and the second of 60 trees from seed planted in November and December, 1915, and set in the field in August, 1917. The development has been vigorous in good soil. The trees differ from those of Robusta in that they are more compact,

[35] Coffees of the Dutch East Indies. Dr. P. J. S. Cramer. Tea and Coffee Trade Jour. (1918), vol. 35, No. 5, p. 420.

the leaves are narrower, and the internodes are shorter, giving to the whole a more densely foliated effect. (Pl. IX, fig. 1.)

Representative leaves are 8½ to 9½ inches long and from less than 3 to 3½ inches wide, the length of some being more than three times the width. The average internodal length on laterals varies from 2 to 3 inches.

The first planting produced a few cherries in the fourth year from seed. The subsequent crops are given in Table 6 and the season of maturity in Table 1. *C. quillou* ripened slightly earlier than did *C. robusta*, but the fruiting habit of the two is similar. The cherries of *C. quillou* are a lighter red than those of *C. robusta*, and some are solid colored while others are striped. They are also less rounded and slightly smaller. Counts of four samples showed between 640 and 726 cherries per liter. The skin is very thin and the yield of marketable coffee to the almud of cherries was the highest of any variety tested, both as to the amount of coffee and proportional reduction in weight. Two almuds of cherries weighed 29 pounds 9 ounces and 31 pounds 6 ounces, respectively. After being pulped and dried, the latter yielded 8 pounds of marketable coffee, a reduction in weight in the ratio of 3.9 to 1. Two pounds were found to contain 3,128 and 3,159 beans, respectively. The bean is less rounded than that of *C. robusta*, being proportionally longer and in some cases rather pointed. Unless the closely adhering brown silver skin is thoroughly removed, the bean presents an unattractive appearance. Where the robustoid coffees are to be planted, this variety would seem worthy of trial.

Coffea Ugandæ Hybrid.

Seed of this hybrid was received from the Java Experiment Station, where this variety is considered the best of the robustoid coffees for the less favorable soils. From seed planted in November, 1916, a small planting was set two years later. Both growth and production have been satisfactory, but the planting is small, and too young as yet to permit of the drawing of definite conclusions. The leaves are considerably smaller than those of Robusta, being 7 to 8 inches long by 3 to 3½ inches wide. In shape they are generally oval, but there is some variation between individuals. The cherry is either striped or solid in color and is on a rather long pedicel, like that of the Arabian. The produce of one individual differs from that of another in both size and shape of bean.

Coffea Congensis Hybrids.

Doctor Cramer, who supplied the station with seed of *C. congensis*, does not include it in the Robusta group, stating in his letter of transmittal that "*C. canephora* enters into the group of *C. robusta*. *C. congensis* and its varieties come nearer to *C. arabica*." He also says that "*C. congensis* var. *chalotii* is probably a hybrid of *C. congensis* with *C. canephora*."[36]

Inasmuch as the two plantings at the station, the first from seed received as *C. congensis* and the second as *C. congensis* var. *chalotii*,

[36] Coffees of the Dutch East Indies. Dr. P. J. S. Cramer. Tea and Coffee Trade Jour. (1919), vol. 36, No. 2, p. 120.

FIG. 1.—COFFEA QUILLOU IN BLOSSOM, FROM ABOVE.

FIG. 2.—COFFEA ROBUSTA IN FRUIT.

FIG. 1.—COFFEA LAURENTII (S. P. I. No. 28080) AT A LITTLE OVER 4 YEARS FROM SETTING.

FIG. 2.—COFFEA ROBUSTA IN BLOSSOM.

FIG. 1.—COFFEA CANEPHORA BENT WITH HEAVY CROP.

FIG. 2.—COFFEA CONGENSIS HYBRID IN FIRST PLANTING.

have many points in common with the Robusta group, it is thought that they are made up chiefly of hybrids of *C. congensis* with members of the Robusta group, and as such they are included here. (Pl. XI, fig. 2.) Seed of both lots was received in December, 1915, and 30 trees of each were set in the field in August, 1917. In the first lot there is a wide variation between individuals. Detached leaves of some trees would readily pass as foliage of Arabian coffee, while those of others resemble the Robusta type more than the Arabian. In leaf dimensions, individuals may vary from 5 to 6 inches long by 2 to 2½ inches broad on branches having 2-inch internodes, to others 8 to 8½ inches long by 3 to 3½ inches broad at nodes more widely spaced. On the whole, the foliage may be considered as intermediate in size between that of the two groups. The young branches point upward. The cherry is either striped or solid in color, flattened, and like the Arabian is borne on a longer pedicel than is true of Robusta.

The second lot, *C. congensis* var. *chalotii*, resembles more closely the Robusta type, with larger leaves 7 to 9 inches long by 3 to 4 inches wide, and cherries that are borne on shorter pedicels. The yield of the two lots is given in Table 6. The first lot, in comparison with the general plantings of Robusta, has been fairly productive.

C. congensis hybrids ripen in the same season as does the Robusta group, which they resemble in size and appearance of cherry, reduction in weight, closely adhering brownish silver skin, and bean. Four counts showed between 612 and 666 cherries, with an average of 638 cherries, per liter. The skin of the cherries is thin, and the beans are the smallest of this group. An almud of fresh cherries weighed 29 pounds 1 ounce, which, after being dried, gave 7 pounds of cleaned coffee beans, a reduction in weight in the ratio of 4.2 to 1.

SUMMARY.

In both area under cultivation and value as an agricultural export, coffee holds second place in Porto Rico.

Porto Rican coffee is of the Arabian type. It is highly esteemed in Europe, but is little known in the United States. It is comparatively low in caffein content.

No distinct varieties of coffee are recognized in Porto Rico, but that produced at the higher altitudes is considered better and sells at a higher price than does coffee grown nearer sea level.

The experiment station has imported and tested numerous varieties from other coffee growing countries. Some of these are indistinguishable from the Porto Rican, and the distinctive flavor for which they are known seems to be modified by the change in environment, while others differ essentially from the Porto Rican.

The ripening season for the different varieties includes every month in the year. Some plantations suffer heavy losses through inability to secure sufficient coffee pickers at the season of heaviest ripening. The planting of varieties which do not mature their main crops simultaneously would help this labor shortage. If sun-drying is practiced, varieties maturing in the dry season offer an advantage over those ripening in the season of heavy rains. Of the coffees tested, three members of the Arabian group—Columnaris, Maragogipe, and San Ramón—mature considerably later than does

the Porto Rican variety. These are followed by the robustoid group, and later still by the Liberian group, of which Excelsa appears to be the latest.

The three groups in which the coffees of commercial interest have been placed were clearly divided as to cherry size, except in case of Maragogipe (large) and Excelsa (small). The Liberian group contains large cherries, and the robustoid group small cherries, nearly twice as many of the latter as of Porto Rican being required to fill a given measure.

The variation in weight of an almud of cherries was slight. The reduction in weight from cherry to marketable bean not only showed marked differences between the groups but a considerable range within the group. The Liberian group suffered the heaviest reduction, the ratio of weight of cherry to marketable bean ranging from 10.2:1 for Liberica to 7.2:1 for Excelsa, an almud of cherries giving 2¾ and 4 pounds, respectively, of marketable coffee. The ratio of reduction for the varieties in the Arabian group ranged from 6.6:1 for Padang to 5.1:1 for San Ramón, which was the only variety in this group showing as favorable a ratio as the Porto Rican. The robustoid group showed the least loss in weight and consequently the most favorable ratio of reduction of any of the groups, the ratio ranging from 4.4:1 for Robusta to 3.9:1 for Quillou, an almud of cherries of the latter giving 8 pounds of marketable coffee.

The groups were not clearly divided as to bean weight. The Liberian group is made up of larger beans than the robustoid. In the Arabian group there is a wide range, from Mocha with the smallest bean to Maragogipe weighing three times as much, and nearly equaling in weight the bean of Liberica, which was the largest of those compared. In the Arabian group Maragogipe was first and Padang was second in bean size, with Columnaris and Erecta comparing favorably with the Porto Rican. The Arabian group ran lowest in peaberries, 6 to 17 per cent; the Liberian group was intermediate with 14 per cent for Liberica to 29 per cent for Excelsa; and the robustoid group was highest, 18 to 41 per cent.

As the coffee planter often sells his product in the parchment, the buyer making an arbitrary deduction of 18 to 20 per cent, according to its condition and appearance, in lieu of actual weight of parchment, a comparison of the varieties for reduction in weight on removal of the parchment was made. The loss for the Liberian group was very high, ranging in the samples examined from 24 to 33 per cent. The Arabian group showed a reduction of 15 to 20 per cent; the Porto Rican, 17 per cent; and the robustoid group showed the least reduction, 12 to 14 per cent.

Of the Arabian coffees imported by the station, Padang, Columnaris, Erecta, and Bourbon have shown themselves to be vigorous and productive under favorable conditions, and of good cup quality. In marketing, they could be mixed with the Porto Rican. A point against Bourbon, however, is the small size of its bean. The growth of Columnaris has been the most vigorous of any of the Arabian coffees.

Maragogipe, notable for its large bean and distinctive flavor, has given too low a yield to warrant commercial plantings.

Mocha, San Ramón, and Murta have given low individual yields, but as the trees of the last two varieties are small, the acre yield

may be increased by closer planting than is advisable for the other coffees. While Mocha is of excellent cup quality and may be grown for home use, it should not be planted for commercial purposes. San Ramón is of very dwarf, stocky, and vigorous habit, and may be useful for planting in windy locations less suitable for varieties of taller, spindling growth. The bean is considerably smaller than that of Porto Rican.

In sections suffering greatly from ravages of the leaf miner it may be advisable to plant coffees of the Liberian group, the foliage of which is less subject to leaf miner attacks, presumably on account of the leathery texture of the leaf. Excelsa seems to be the most promising of this group so far tested. Certain individuals of Dewevrei have shown themselves very prolific and give much promise.

The Robusta and related varieties are planted in certain coffee-growing countries for their heavy production. While the average production for this station has not been high, the tests have been of shorter duration than for the Arabian varieties. The yield of certain individuals has been high, indicating either heavy-yielding strains or heavy yields for plantings under favorable conditions. Notwithstanding the many points in its favor, Robusta coffee is inferior in cup quality, a fact which should be borne in mind by those contemplating planting it.

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